



Muñoz-Neira, C., Henríquez Chaparro, F., Delgado, C., Brown, J., & Slachevsky, A. (2014). Test Your Memory-Spanish version (TYM-S): a validation study of a self-administered cognitive screening test. *International Journal of Geriatric Psychiatry*, 29(7), 730-40.  
<https://doi.org/10.1002/gps.4055>

Peer reviewed version

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# **Test Your Memory-Spanish Version (TYM-S): A Validation Study of a Self-Administered Cognitive Screening Test**

Journal:	<i>International Journal of Geriatric Psychiatry</i>
Manuscript ID:	GPS-13-0103.R1
Wiley - Manuscript type:	Research Article
Date Submitted by the Author:	n/a
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Keywords:	Dementia, Alzheimer's disease, Mild cognitive impairment, Self-administered cognitive screening test, TYM, Test Your Memory-Spanish Version

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**Test Your Memory-Spanish Version (TYM-S): A Validation Study of a Self-Administered Cognitive Screening Test**

**Properties of the TYM in a Sample of Spanish-Speaking Elderly People**

**Keywords:**

Dementia, Alzheimer’s disease, Mild cognitive impairment, Self-administered cognitive screening test, TYM, Test Your Memory-Spanish Version

**Key points:**

- The TYM-S is a valid and reliable cognitive screening tool that quickly assesses several cognitive domains.
- The TYM-S has an acceptable diagnostic utility for distinguishing cases of dementia from controls in a sample of Spanish-speaking elderly people.
- The TYM-S correlates significantly with other measures of global cognitive impairment, executive dysfunction, dementia severity, functional capacity in activities of daily living, and cognitive change.
- The TYM-S may be a convenient option for assessing cognitive complaints in different Spanish-speaking clinical settings instead of other widely popular measures such as the MMSE and ACE-R.

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Funding: FONDECYT Project N° 1100975 and PIA-CONICYT Project CIE-05.

The authors do not have conflicts of interest.

Word count of the text = 3495

**Abstract**

**Objective:** To develop the TYM-Spanish Version (TYM-S), a self-administered cognitive screening test, in a Chilean elderly sample and to estimate its psychometric properties and diagnostic accuracy.

**Methods:** The TYM was translated into Spanish and adapted for a Chilean population to develop the TYM-S. Measures of global cognitive impairment and executive dysfunction were administered to 30 controls, 30 dementia patients, and 14 subjects with mild cognitive impairment (MCI). All participants' proxies were interviewed with assessments of dementia severity, functionality in daily living activities, and cognitive change. Convergent validity and internal consistency reliability of the TYM-S were estimated. Cut-off points, sensitivity, and specificity were determined to test its diagnostic capacity for dementia or MCI.

**Results:** Regarding convergent validity, the TYM-S was significantly correlated ( $p<.001$ ) with global cognitive impairment (MMSE:  $r=.902$ ; ACE-R-Ch:  $r=.922$ ; MoCA:  $r=.923$ ), executive dysfunction (FAB:  $r=.862$ ), dementia severity (CDR:  $r=-.757$ ), functional capacity (T-ADLQ:  $r=-.864$ ; PFAQ:  $r=-.748$ ; IADL:  $r=.769$ ), and cognitive change (AD8-Ch:  $r=-.700$ ) measures. Regarding reliability, Cronbach's  $\alpha$  was .776. Optimum cut-off scores of 39 and 44 distinguished dementia cases from controls (93.1% sensitivity, 82.2% specificity) and MCI cases from controls (85.7% sensitivity, 69% specificity), respectively. The extent of assistance required in the TYM-S and cognitive impairment were correlated.

**Conclusions:** The TYM-S is a valid and reliable instrument to assess cognitive impairment, showing good psychometric properties and diagnostic capacity to identify cases of dementia in a Spanish-speaking elderly cohort. While its need for assistance

may be limiting, its ability to quickly assess several cognitive domains supports widespread clinical use.

For Peer Review

Introduction

Dementia is a major public health concern of the 21st century for many reasons, chief among these being its high psychosocial impact (Thies and Bleiler 2012). Prevalence of dementia increases exponentially with age, affecting approximately one in ten people over the age of 65 and half of people over 85 (Evans, et al. 1989; Fitzpatrick, et al. 2004). Thirty-six million people worldwide are estimated to suffer from dementia nowadays and this number is expected to triple by 2040 (Reitz, et al. 2011; Wimo and Prince 2010). In 2011, an estimated 60% of dementia patients lived in low- and middle-income countries whereas by 2040, this percentage is expected to reach 71% (Prince, et al. 2007).

Proper screening tools for dementia that are sufficiently sensitive, yet easily administered, must be developed to overcome several hurdles in early diagnosis of these patients (Cullen, et al. 2007; Scharre, et al. 2010; Villarejo and Puertas-Martin 2011). A large number of brief cognitive measures exist; however, many present disadvantages, such as requiring too much time and qualified personnel while others are simply too cumbersome to administer in busy clinical settings (Boustani, et al. 2005). Moreover, potential drawbacks of informant-based assessments to identify early dementia are that patients are often assessed alone and may not have a reliable or accessible informant (Scharre et al. 2010).

Three requirements for widespread use of a cognitive screening test by non-specialists have been identified: minimal administration time, assessment of a reasonable range of cognitive functions, and sensitivity to mild Alzheimer’s disease (AD) (Brown, et al. 2009). Allowing patients to fill in a test themselves may overcome the paradox of thorough testing in minimal time. The Test Your Memory (TYM) (Brown et al.

2009) is a self-administered cognitive screening test developed to fulfill the three aforementioned requirements to facilitate its broad use in clinical settings. It is a valid and reliable instrument with very good psychometric properties to identify dementia or cognitive impairment. Moreover, the TYM has been shown to better detect AD compared to more traditional cognitive screening tests, such as the Mini-Mental State Examination (MMSE) and Addenbrooke's Cognitive Examination-Revised (ACE-R) (Brown et al. 2009). Furthermore, the instrument has been validated in Afrikaans, Japanese, Chinese, and Polish populations in addition to a large cohort of unselected English patients from cognitive clinics (Brown et al. 2009; Hancock and Lerner 2011; Hanyu, et al. 2011; Hou and Lee 2011; Szczesniak, et al. 2013; van Schalkwyk, et al. 2012).

The aim of this study was to develop the TYM-Spanish Version (TYM-S) and to study its psychometric properties and diagnostic utility for identifying dementia or mild cognitive impairment in a Chilean elderly sample. To further validate the TYM-S, its scores were compared to those obtained on other measures of global cognitive impairment, executive dysfunction, dementia severity, functional capacity, and cognitive change.

## Methods

### Development of the TYM-S

To generate the TYM-S, the original TYM was translated into Spanish and later adapted for a Spanish context by a neurologist (ASC) and two psychologists (CMN, FHC). The resulting version was back-translated into English, showing clear consistency with the original instrument. Two sections of the original, Semantic Knowledge and



Verbal Fluency, were modified to improve their comprehension and cultural adequacy for Spanish speakers and the Chilean population (see Appendix 1).

The TYM is presented on a double-sided sheet of paper with spaces for the patient to fill in. Its scores range from 1 to 50. The test comprises of 10 tasks assessing 11 cognitive domains: orientation, copying (ability to copy a sentence), semantic knowledge (retrograde memory), calculation, verbal fluency (phonemic), abstraction (similarities), naming, visuospatial abilities, anterograde memory, and executive function (EF) or capacity to complete the test without help (Table 1). If necessary, patients can be assisted with any part of the test except the answers. There is no time limit. Detailed instructions of the TYM are described by Brown et al. (2009).

**Participants**

A convenience sample of Spanish speakers was recruited from the Cognitive Neurology and Dementia Unit of the Hospital del Salvador in Santiago, Chile. Inclusion criteria comprised of subjects 65 years old or older without conditions that could preclude a neuropsychological assessment (e.g. sensory disturbances such as visual/auditory impairments). All participants had proxies who shared relevant information about participants' everyday activities and behavior, and provided informed consent prior to study inclusion. In cases of marked cognitive impairment where informed consent could be misunderstood, consent was provided by the collateral sources who took care of the patient. Exclusion criteria included illiteracy, debilitating cognitive impairment that could interfere with neuropsychological assessment, underlying medical or psychiatric illness that could affect cognition, and absence of a reliable proxy.

The sample was divided into three groups. There were 30 control participants

without preexisting neurological or psychiatric disorders that could cause neuropsychological disturbance, 30 patients with dementia [20 with AD, 4 with frontotemporal dementia (FTD), 4 with dementia with Lewy bodies (DCL), 2 with vascular dementia (VD)], and 14 participants with amnesic or multidomain mild cognitive impairment (MCI). All participants had appropriate Clinical Dementia Rating (CDR) scale scores (controls = 0, dementia  $\geq 1$ , MCI  $\leq .5$ ,) (Hughes, et al. 1982; Morris 1993).

All controls had normal cognition based on local normative data for the MMSE (González-Hernández, et al. 2009) and Frontal Assessment Battery (FAB) (Alegría 2005), and were deemed cognitively normal by the neurologist. A neurologist diagnosed dementia and MCI based on detailed neurological, neuropsychological, laboratory, and neuroimaging data for each participant. The first step in diagnosing dementia was to determine the presence or absence of the disease using criteria in the Diagnostic and Statistical Manual of Mental Disorders (4th edition, text revision) (American Psychiatric Association 2000). If criteria were met, the specific type of dementia was specified using multiple diagnostic criteria: (a) National Institute of Neurological and Communicative Disorders and Stroke-AD and Related Disorders Association criteria for AD, (b) the consensus criteria for FTD diagnosis, (c) the third report of the Dementia with Lewy Bodies Consortium criteria for DCL, and (d) AD Diagnostic and Treatment Centers criteria and National Institute of Neurological Disorders and Stroke criteria for VD (McKeith, et al. 2005; McKhann, et al. 1984; Neary, et al. 1998; Roman, et al. 1993). MCI diagnosis was established according to the International Working Group on MCI consensus criteria (Winblad, et al. 2004).

The CDR scale was administered to all proxies. Afterward, the proxies were asked to complete a set of questionnaires including assessments of functional capacity and cognitive change.

This study was approved by the Ethical and Scientific Committee of the Servicio de Salud Metropolitana Oriente in Santiago, Chile.

Assessment and Materials

To study the convergent validity of the TYM-S, global cognitive impairment was measured in addition to three Chilean versions of neuropsychological instruments: the MMSE (González-Hernández et al. 2009), the ACE-R (ACE-R-Ch) (Muñoz-Neira, et al. 2012), and the Montreal Cognitive Assessment (MoCA) (Araneda, et al. 2013). The FAB was considered a global measure of executive dysfunction (Alegría 2005; Dubois, et al. 2000). To determine if the TYM-S was a valid measure of dementia severity, the CDR scale assessed clinical progression and stages of dementia. Proxies also completed three functionality scales: the Technology-Activities of Daily Living Questionnaire (T-ADLQ) (Munoz-Neira, et al. 2012), Pfeffer Functional Activities Questionnaire (PFAQ) (Pfeffer, et al. 1982), and Instrumental Activities of Daily Living (IADL) (Lawton 1988). The AD8-Chilean Version (AD8-Ch) was used as an indicator of cognitive change (Munoz, et al. 2010).

Procedures and Statistical Analysis

Descriptive and comparative analyses were conducted using either a one-way analysis of variance (ANOVA) to compare the three groups for continuous variables or the  $\chi^2$  test for categorical variables. A multiple regression analysis evaluated which demographic variables were associated with TYM-S performance in the entire sample.

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3 Additionally, a one-way multivariate ANOVA compared responses to TYM-S items  
4 across diagnostic categories. Convergent validity of the TYM-S was evaluated using  
5 Pearson correlation between TYM-S scores and results of the other instruments  
6 administered. Internal consistency was measured with Cronbach's  $\alpha$ , which reflects the  
7 average inter-item correlation and thus increases when correlations among items  
8 increase (Bland and Altman 1997). Two receiver operating characteristic (ROC)  
9 analyses were performed to determine the ability of the TYM-S and the other cognitive  
10 assessments to discriminate between dementia patients ( $CDR \geq 1$ ) and controls ( $CDR =$   
11  $0$ ), and between MCI patients ( $CDR = 0.5$ ) and controls ( $CDR = 0$ ). Analyses were  
12 carried out to select an optimal TYM-S cut-off score, below which an individual has a  
13 very high chance of having dementia or MCI. The area under the curve (AUC) measured  
14 diagnostic utility of the TYM-S in distinguishing dementia or MCI patients from controls.  
15 AUC values less than perfect (1.0) were classified as having excellent ( $> .9$ ), good ( $>$   
16  $.8$ ), fair ( $> .7$ ), or poor ( $> .6$ ) utility (Gifford and Cummings 1999). All analyses were  
17 conducted at  $p < .05$  (two-tailed) using the Statistical Package for the Social Sciences  
18 (SPSS) version 20 for Windows (IBM Corp., Armonk, NY, USA). Effect sizes (Cohen's  $d$   
19 statistic) were also calculated to determine the magnitude of group differences on the  
20 instrument. According to Cohen (1988), effect sizes are categorized as small ( $.2$  to  $.49$ ),  
21 medium ( $.5$  to  $.79$ ), or large (greater than  $.8$ ). Positive effect sizes indicate lower  
22 performance in people with dementia and MCI compared with controls.  
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## Results

### Demographic and Clinical Data

55 The total sample included 74 participants (42 men, 32 women). Table 2  
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summarizes their demographic characteristics and clinical profiles. No significant differences ( $p > .05$ ) were found among groups with respect to age ( $F_{(2, 73)} = 0.164, p = .849$ ), years of education ( $F_{(2, 73)} = 0.957, p = .389$ ), or sex ( $\chi^2 = 1,088, GL = 2, p = .581$ ). The three groups did differ significantly in measures of global cognitive impairment (MMSE:  $F_{(2, 73)} = 56.820$ ; ACE-R-Ch:  $F_{(2, 73)} = 74.492$ ; MoCA:  $F_{(2, 73)} = 55.702$ ; all  $p$ 's  $< .001$ ), executive dysfunction (FAB:  $F_{(2, 73)} = 28.916, p < .001$ ), dementia severity (CDR:  $F_{(2, 73)} = 103.905, p < .001$ ), functional capacity (T-ADLQ:  $F_{(2, 73)} = 47.106$ ; PFAQ:  $F_{(2, 73)} = 48.374$ ; IADL:  $F_{(2, 73)} = 47.472$ ; all  $p$ 's  $< .001$ ), and cognitive change (AD8-Ch:  $F_{(2, 73)} = 47.915, p < .001$ ). Details of the post-hoc analysis are specified in Table 2. Dementia patients performed significantly worse than MCI patients and controls while MCI patients performed significantly worse than controls on measures of global cognitive impairment, executive dysfunction, disease severity, functional capacity, and cognitive change.

**Administration of the TYM-S**

All participants completed the TYM-S with an average time of 11.28 minutes (range: 8-18 minutes). The three groups differed significantly in completion time ( $F_{(2, 73)} = 8.061, p < .01$ ) and the amount of help needed with the test ( $F_{(2, 73)} = 8.061, p < .01$ ). The observed assistance level in the TYM-S reached 33.3% in controls, 90% in dementia, and 71.43% in MCI. Performance on the TYM-S is detailed in Table 3.

**Influence of Demographic Variables on TYM-S Performance**

To determine the effects of demographic variables on TYM-S performance for all participants, a multiple regression analysis (Enter Method) was performed with TYM-S scores as dependent variables and participant-based variables (age, years of education, sex) as independent variables. The resulting regression model excluded age and sex as

important factors. Years of education had a positive effect ( $\beta$  coefficient = .31,  $p < .001$ ) and explained 15% of the total variance in TYM-S scores ( $r^2 = .150$ ,  $F_{(2, 70)} = 4.12$ ,  $p = .009$ ).

### Convergent Validity and Reliability of the TYM-S

The TYM-S showed statistically significant associations with other measures of global cognitive impairment, executive dysfunction, dementia severity, functional capacity, and cognitive change (Table 4). Cronbach's  $\alpha$  was .776, suggesting high internal consistency of the 11 items of the TYM-S.

### Divergent Validity, Sensitivity, and Specificity of the TYM-S

Table 3 summarizes the global and individual item TYM-S scores for the three groups. A one-way multivariate ANOVA revealed a significant multivariate main effect of diagnosis (Wilks's lambda = .273,  $F_{(20, 124)} = 5.662$ ,  $p < .001$ , partial eta squared = .477, with a power of 1.00 to detect the effect). The three groups differed significantly in average TYM-S scores ( $F_{(2, 73)} = 47.963$ ,  $p < .001$ ). Significant differences were found among controls, dementia patients, and participants with MCI for each TYM-S item (orientation:  $F_{(2, 73)} = 34.477$ ; copying:  $F_{(2, 73)} = 5.151$ ; semantic knowledge:  $F_{(2, 73)} = 39.824$ ; calculation:  $F_{(2, 73)} = 6.571$ ; verbal fluency:  $F_{(2, 73)} = 14.225$ ; abstraction:  $F_{(2, 73)} = 14.631$ ; naming:  $F_{(2, 73)} = 16.621$ ; visuospatial abilities:  $F_{(2, 73)} = 28.200$ ; anterograde memory:  $F_{(2, 73)} = 30.121$ ; EF:  $F_{(2, 73)} = 28.134$ ; all  $p$ 's  $< .001$ ). Details of the post-hoc analysis are presented in Table 3.

Results of the ROC curve analyses for the TYM-S and the other cognitive measures are displayed in Table 5 and Figure 1. It should be noted that the TYM-S distinguished between dementia patients and controls (AUC = .963) better than between MCI patients and controls (AUC = .826). A cut-off point of 39 was optimal for detecting

dementia using the TYM-S with a sensitivity of 93.1% and a specificity of 82.2% [95% CI (.922, 1.00)], indicating high overall diagnostic utility of the test to identify cases of dementia. A cut-off point of 44 discriminated MCI patients from controls and had a sensitivity of 85.7% and a specificity of 69% [95% CI (.697, .956)]. No significant differences in AUC among the TYM-S, MMSE, ACE-R-Ch, MoCA, and FAB ( $p > .05$ ) emerged between the dementia versus control groups, as well as between the MCI versus control groups (Hanley and McNeil 1983).

The standardized mean difference (Cohen's  $d$ ) for the TYM-S was 2.41 ( $r = .77$ ) between dementia patients and controls, 1.50 ( $r = .60$ ) between dementia and MCI patients, and 1.20 ( $r = .51$ ) between MCI patients and controls.

Discussion

This study provided evidence to support the use of the TYM-S as a valid and reliable instrument for assessing cognitive impairment in a Chilean Spanish-speaking elderly cohort. In addition to its good psychometric properties, the TYM-S showed an acceptable diagnostic utility for identifying cases of dementia.

Strong and statistically significant relationships found between the TYM-S and measures of global cognitive impairment (MMSE, ACE-R-Ch, MoCA), executive dysfunction (FAB), dementia severity (CDR), and functional impairment (T-ADLQ, PFAQ, IADL) supported its validity. These findings are consistent with previous validation studies of the instrument. For example, the original publication by Brown et al. (2009) demonstrated Pearson correlations between TYM scores and the MMSE (.55,  $p \leq .001$ ) and ACE-R (.66,  $p \leq .001$ ) in 540 controls and 139 patients with dementia or amnesic MCI, supporting good convergent validity. The TYM-Japanese Version (TYM-



J) (Hanyu et al. 2011) showed good convergent validity with the MMSE ( $r = .68$ ), Wechsler Memory Scale-Revised (WMS-R) Logical Memory I ( $r = .71$ ), AD Assessment Scale-Cognitive Subscale-Japanese Version (ADAS-Jcog;  $r = .74$ ), and FAB ( $r = .66$ ); all  $p$ 's  $< .0001$ . Furthermore, English and Afrikaans versions of the TYM have shown good associations with the MMSE ( $r = .455$  for English-speakers,  $r = .747$  for Afrikaans-speakers;  $p < .001$ ) (van Schalkwyk et al. 2012). Chinese (Hou and Lee 2011) and Polish (Szczesniak et al. 2013) validation studies have also reported acceptable correlations between the TYM and other cognitive measures.

The important association between the TYM-S and measures of both global cognitive impairment and executive dysfunction suggests that the TYM is sensitive to executive disorders. This is crucial for a screening instrument since executive dysfunction is often the earliest and most prominent sign of certain dementias, including syndromes such as FTD (the behavioral variant) (Torralva, et al. 2008) and VD (Graham, et al. 2004; Merino and Hachinski 2008). Assessment of executive function contributes to early diagnosis; therefore, such tasks should be included in cognitive tools. Indeed, a main limitation of the MMSE as a screening instrument is its poor sensitivity in detecting executive dysfunction (Dubois et al. 2000).

To the best of our knowledge, this is the first study reporting a correlation between performance on the TYM and MoCA, which has shown an excellent ability to detect dementia or MCI by assessing multiple cognitive domains (Nasreddine, et al. 2005).

Similar to the aforementioned Chinese study, the TYM-S was also associated with the CDR, a measure of dementia severity. Besides, the present study provides additional evidence for the validity of the TYM by showing its correlation with measures



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3 of executive dysfunction (FAB), functional impairment (T-ADLQ, PFAQ, IADL scale), and  
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5 the informant-based assessment of cognitive change (AD8-Ch). The strong correlation  
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7 between the TYM-S and functional ability is remarkable for a cognitive screening test  
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9 given that functional impairment or disability is an essential aspect of identifying  
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11 dementia (Royall, et al. 2007).  
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15 Our study found the TYM-S had high internal consistency, supporting its  
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17 reliability. Acceptable reliability data have also been identified in other studies of the  
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19 TYM (Brown et al. 2009; Hou and Lee 2011; Szczesniak et al. 2013; van Schalkwyk et  
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21 al. 2012).  
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25 The diagnostic utility of the TYM-S to distinguish cases of dementia from controls  
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27 is supported by the AUC and its acceptable sensitivity, specificity, and Cohen's d values.  
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29 The small sample size of MCI patients may have interfered on the results obtained to  
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31 discriminate these individuals from controls. In their original study, Brown et al. (2009)  
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33 reported that a TYM cut-off score of  $\leq 42$  showed 93% sensitivity and 86% specificity for  
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35 AD diagnosis. Another study of memory clinic patients proposed adjusting the cut-off to  
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37 30 which maintained acceptable sensitivity (73%) and specificity (88%) (Hancock and  
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39 Larner 2011). Hanyu et al. (2011) proposed two cut-off points for the TYM-J: one at 42  
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41 or 43 with 96% sensitivity and 91% specificity to distinguish AD patients from controls  
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43 and another at 44 or 45 with 76% sensitivity and 74% specificity to differentiate MCI  
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45 patients from healthy controls. In that study, the AUC was significantly better for the  
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47 TYM-J than for the MMSE, WMS-R Logical Memory I, and ADAS-Jcog. The South  
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49 African study of 100 participants showed that both English and Afrikaans versions  
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51 performed very well in detecting cognitive impairment (van Schalkwyk et al. 2012).  
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53 Although the TYM-S had excellent psychometric properties and diagnostic utility for  
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3 identifying cognitive impairment, the ROC curve analysis suggested that it did not  
4 discriminate between dementia or MCI patients and controls significantly better than the  
5 MMSE, ACE-R-Ch, MoCA, or FAB. Nevertheless, the TYM-S has advantages as a quick  
6 assessment of several cognitive functions, making it a promising alternative to cognitive  
7 tools that are not self-administered.  
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15 The current research reported longer completion times (range: 8-18 minutes) for  
16 the TYM-S than previous studies, which might be deemed too lengthy in many clinical  
17 settings (Tangalos, et al. 1996). Considering that TYM-S administration does not require  
18 the presence of a professional but only supervision by a non-professional in a separate  
19 waiting room, this duration is probably not a limitation. In any case, it should be  
20 acknowledged that the self-report format of the TYM solves the paradox of achieving  
21 thorough testing in minimal time (Brown et al. 2009). This feature should be especially  
22 useful in primary care where clinicians lack sufficient time to administer a detailed  
23 diagnostic interview or cognitive assessment.  
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37 Another important point is the number of cognitively impaired participants who  
38 required some level of assistance with the TYM-S, which may suggest that the test is  
39 more suitable for controls or individuals with minimal cognitive impairment rather than  
40 moderate-to-severe dementias. This limitation could restrict the TYM-S as a self-  
41 administered tool; however, the test does assess the level of help given by an examiner  
42 which factors into the overall result. Despite the possibility that the considerable amount  
43 of assistance observed may reduce the overall utility of the TYM-S, its ability to quickly  
44 assess several cognitive domains supports its widespread use in different clinical  
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Our study found that TYM-S performance was not correlated with age, which may reflect the fact that the sample was older than 60 years. As expected, TYM-S performance was influenced by years of education, supporting the established notion that education affects cognitive outcomes (Lezak 2012). This suggests the need for normative data on the TYM-S that considers educational level or a normative study to determine a better cut-off according to educational level.

The main limitation of this study is the use of a small convenience sample that could preclude a generalization of the results obtained to an unselected population. Indeed, Hancock and Larner (2011) have pointed out that index studies of new test instruments are conducted in ideal diagnostic circumstances and/or with ideal patients, which is not representative of day-to-day clinical practice.

To conclude, this study found that the TYM-S is a valid and reliable instrument to identify cases of dementia with acceptable diagnostic utility. Future research should be conducted with larger samples and examine the utility of the TYM-S when studying participants with MCI alone. Evaluating the utility of the tool in the psychiatric population may also be of interest. Studies must be conducted in an unselected population of cognitive clinic patients or those in primary care to determine the best cut-off point of the TYM-S in general practice.

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Table 1  
*Items of the Test Your Memory*

Domain/Task	Score
Orientation	10
Copying (Ability to Copy a Sentence)	2
Semantic Knowledge (Retrograde Memory)	3
Calculation	4
Verbal Fluency (Phonemic)	4
Abstraction (Similarities)	4
Naming	5
Visuospatial Abilities (Letter W and Clock Test)	7
Anterograde Memory (Recall of a Copied Sentence)	6
Executive Function (Capacity to Complete the Test Without Help)	5
Total	50

Table 2  
Demographic Characteristics and Clinical Profiles of the Sample

Parameter	Descriptive Statistics by Group			Comparison		
	Control (n = 30)	Dementia (n = 30)	MCI (n = 14)	Dementia vs. Control	Dementia vs. MCI	MCI vs. Control
<b>Age</b> ¥	71.93 ± 7.06	72.80 ± 6.90	71.71 ± 7.16	<i>ns</i>	<i>ns</i>	<i>ns</i>
<b>Years of Education</b> ¥	14.00 ± 4.20	12.70 ± 3.15	12.79 ± 4.59	<i>ns</i>	<i>ns</i>	<i>ns</i>
<b>Sex</b> □				<i>ns</i>	<i>ns</i>	<i>ns</i>
%Men (n)	50.00% (15)	6.30% (19)	57.10% (8)			
%Women (n)	50.00% (15)	36.70% (11)	42.90% (6)			
<b>TYM-S</b>	43.93 ± 5.55 (30-50)	22.50 ± 11.29 (2-42)	36.50 ± 6.81 (23-47)	*	*	*
<b>MMSE</b>	28.77 ± 1.14 (27-30)	20.90 ± 4.15 (13-29)	26.29 ± 2.13 (22-29)	*	*	*
<b>ACE-R-Ch</b>	91.50 ± 6.85 (77-100)	59.47 ± 13.69 (34-87)	79.50 ± 6.95 (68-92)	*	*	*
<b>MoCA</b>	25.07 ± 3.25 (18-30)	13.90 ± 5.17 (5-23)	19.93 ± 2.95 (16-26)	*	*	*
<b>FAB</b>	16.00 ± 1.71 (12-18)	11.17 ± 3.01 (6-17)	14.21 ± 2.36 (10-17)	*	*	<i>ns</i>
<b>CDR scale</b>	0.00 ± 0.00 (0-0)	1.67 ± 0.71 (0.5-0.5)	0.50 ± 0.00 (1-3)	*	*	*
<b>T-ADLQ</b>	12.00 ± 10.39 (0-36)	46.21 ± 18.33 (12-82)	19.93 ± 8.54 (9-32)	*	*	*
<b>PFAQ</b>	0.63 ± 1.38 (0-6)	13.53 ± 8.37 (0-27)	1.21 ± 1.53 (0-4)	*	*	<i>ns</i>
<b>IADL scale</b>	7.40 ± 0.93 (5-8)	3.87 ± 1.91 (0-7)	7.07 ± 1.44 (4-8)	*	*	<i>ns</i>
<b>AD8-Ch</b> ¥	1.47 ± 1.98 (0-8)	6.30 ± 1.95 (2-8)	3.29 ± 1.73 (1-6)	*	*	*

Note. Results are expressed as  $M \pm SD$ . MCI = Mild Cognitive Impairment; TYM-S = Test Your Memory-Spanish Version; MMSE = Mini-Mental State Examination; ACE-R-Ch = Addenbrooke's Cognitive Examination-Revised-Chilean Version; MoCA = Montreal Cognitive Assessment; FAB = Frontal Assessment Battery; CDR = Clinical Dementia Rating; T-ADLQ = Technology-Activities of Daily Living Questionnaire; PFAQ = Pfeffer Functional Activities Questionnaire; IADL = Instrumental Activities of Daily Living; AD8-Ch = Alzheimer's Disease 8-Chilean Version.

□ Chi-square test applied. All other comparisons were carried out with an ANOVA test.

¥ Tukey post hoc tests applied. All other measures were compared with Games-Howell tests.

\* $p < .05$ .

Table 3  
Detailed Scores on the TYM-S

Parameter	Descriptive Statistics by Group			Comparison		
	Control (n = 30)	Dementia (n = 30)	MCI (n = 14)	Dementia vs. Control	Dementia vs. MCI	MCI vs. Control
<b>TYM-S</b>	43.93 ± 5.55	22.50 ± 11.29	36.50 ± 6.81	*	*	*
<b>Orientation</b>	9.67 ± 0.48	5.77 ± 2.71	8.57 ± 1.34	*	*	*
<b>Copying</b>	1.80 ± 0.55	1.20 ± 0.89	1.64 ± 0.74	*	*	ns
<b>Semantic Knowledge</b>	2.90 ± 0.31	1.10 ± 1.09	2.36 ± 0.74	*	*	*
<b>Calculation</b>	3.40 ± 0.86	2.30 ± 1.44	2.93 ± 1.14	*	ns	ns
<b>Verbal Fluency</b>	3.57 ± 0.77	2.10 ± 1.32	2.71 ± 0.99	*	ns	*
<b>Abstraction</b>	3.57 ± 0.77	1.97 ± 1.56	3.21 ± 0.89	*	*	ns
<b>Naming</b>	4.70 ± 0.95	2.63 ± 1.90	4.29 ± 1.07	*	*	ns
<b>Visuospatial Abilities</b>	6.07 ± 1.34	2.53 ± 2.39	5.21 ± 1.53	*	*	ns
<b>Letter WM</b>	2.20 ± 1.13	0.70 ± 1.06	1.64 ± 1.22	*	*	ns
<b>Clock Drawing Test</b>	3.87 ± 0.43	1.83 ± 1.62	3.57 ± 0.76	*	*	ns
<b>Anterograde Memory</b>	3.70 ± 2.09	0.30 ± 1.12	1.71 ± 1.82	*	*	ns
<b>Executive Function</b>	4.57 ± 0.73	2.60 ± 1.25	3.86 ± 1.03	*	*	*
<b>Need for Assistance on the TYM-S</b>						
No assistance	66.67%	10%	28.57%			
Trivial assistance	26.67%	10%	42.86%			
Minor assistance	3.33%	33.33%	14.29%			
Moderate assistance	3.33%	23.33%	14.29%			
Major assistance	0%	23.33%	0%			
<b>Completion Time</b>	7.60 ± 0.75 (range: 6.09-9.11)	14.27 ± 0.69 (range: 12.87-15.65)	11.51 ± 0.95 (range: 9.6-13.42)			

Note. Results are expressed as *M* ± *SD*. MCI = Mild Cognitive Impairment; TYM-S = Test Your Memory-Spanish Version.  
‡Tukey post hoc tests applied. All other measures were compared with Games-Howell tests.  
\**p* < .05.

Table 4  
Convergent Validity of the TYM-S

Assessment	Instrument	TYM-S
Global Cognitive Impairment	MMSE	.902□
	ACE-R-Ch	.922□
	MoCA	.923□
Executive Dysfunction	FAB	.862□
Dementia Severity	CDR scale	-.757□
Functional Capacity	T-ADLQ	-.864□
	PFAQ	-.748□
	IADL scale	.769□
Cognitive Change	AD8-Ch	-.700□

*Note.* TYM-S = Test Your Memory-Spanish Version; MMSE = Mini-Mental State Examination; ACE-R-Ch = Addenbrooke's Cognitive Examination-Revised-Chilean Version; MoCA = Montreal Cognitive Assessment; FAB = Frontal Assessment Battery; CDR = Clinical Dementia Rating; T-ADLQ = Technology-Activities of Daily Living Questionnaire; PFAQ = Pfeffer Functional Activities Questionnaire; IADL = Instrumental Activities of Daily Living; AD8-Ch = Alzheimer's Disease 8-Chilean Version.

□ Pearson correlation coefficient,  $p < .001$ .

Table 5  
Receiver Operating Characteristic Curves for the TYM-S and Other Cognitive Screening Tests

Comparison	Instrument	Area Under Curve	Cut-Off Point	Sensitivity	Specificity	(CI 95%)
Dementia versus Control	TYM-S	.963	39	.931	.862	.922; 1.00
	MMSE	.974	28	.931	.828	.934; 1.00
	ACE-R-Ch	.984	79	.931	.966	.960; 1.00
	MoCA	.970	21	.931	.897	.936; 1.00
	FAB	.910	15	.862	.793	.837; .983
MCI versus Control	TYM-S	.826	44	.857	.690	.697; .956
	MMSE	.867	29	.857	.655	.754; .980
	ACE-R-Ch	.901	86	.857	.793	.813; .990
	MoCA	.873	24	.929	.0690	.768; .978
	FAB	.729	17	.857	.552	.576; .882

Note. MCI = Mild Cognitive Impairment; TYM-S = Test Your Memory-Spanish Version; MMSE = Mini-Mental State Examination; ACE-R-Ch = Addenbrooke's Cognitive Examination-Revised-Chilean Version; MoCA = Montreal Cognitive Assessment; FAB = Frontal Assessment Battery.

Figure 1  
Receiver Operating Characteristic Curves for the TYM-S and Other Cognitive Screening Tests

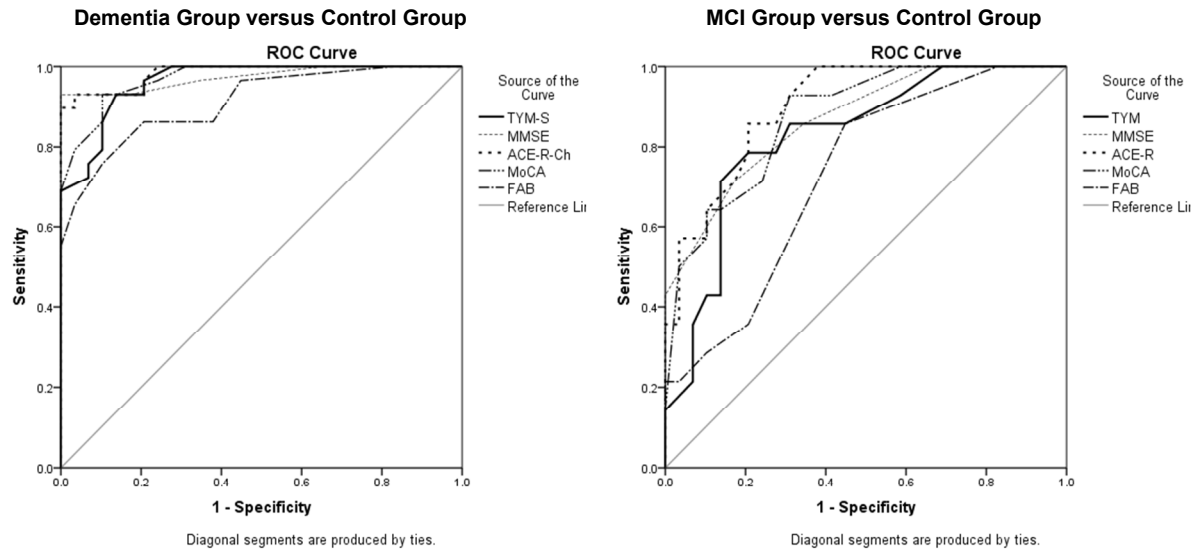


Figure 1. Receiver operating characteristic (ROC) curves for the TYM-S and other cognitive screening tests. TYM-S = Test Your Memory-Spanish Version; MMSE = Mini-Mental State Examination; ACE-R-Ch = Addenbrooke's Cognitive Examination-Revised-Chilean Version; MoCA = Montreal Cognitive Assessment; FAB = Frontal Assessment Battery.



PRUEBA TU MEMORIA

(TEST YOUR MEMORY - THE TYM TEST-)

Por favor, escriba su nombre completo \_\_\_\_\_

/10

Hoy es, (complete con el día de la semana) \_\_\_\_\_

La fecha de hoy es: (número de día) \_\_\_\_ de (mes) \_\_\_\_\_ de (año) \_\_\_\_\_

¿Qué edad tiene usted? \_\_\_\_ años

¿En qué fecha nació? (número de día) \_\_\_\_ / (mes) \_\_\_\_\_ / año \_\_\_\_\_

**POR FAVOR, COPIE A CONTINUACIÓN, EN LA LÍNEA DE ABAJO, LA SIGUIENTE ORACIÓN:**

/2

LOS BUENOS CIUDADANOS SIEMPRE USAN ZAPATOS OSCUROS

**POR FAVOR, LEA NUEVAMENTE LA ORACIÓN Y TRATE DE RECORDARLA**

¿Quién es el presidente de este país? \_\_\_\_\_

/3

¿En qué año comenzó el último gobierno militar en este país? \_\_\_\_\_

Operaciones numéricas

$20 - 4 = \underline{\hspace{2cm}}$

$16 + 17 = \underline{\hspace{2cm}}$

$8 \times 6 = \underline{\hspace{2cm}}$

$4 + 15 - 17 = \underline{\hspace{2cm}}$

/4

Por favor, escriba 4 animales (de cualquier tipo) que comiencen con la letra P, como por ejemplo, Pelicano:

/4

1 P \_\_\_\_\_

2 P \_\_\_\_\_

3 P \_\_\_\_\_

4 P \_\_\_\_\_

¿En qué se parecen, o tienen en común, una zanahoria y una papa? \_\_\_\_\_

/4

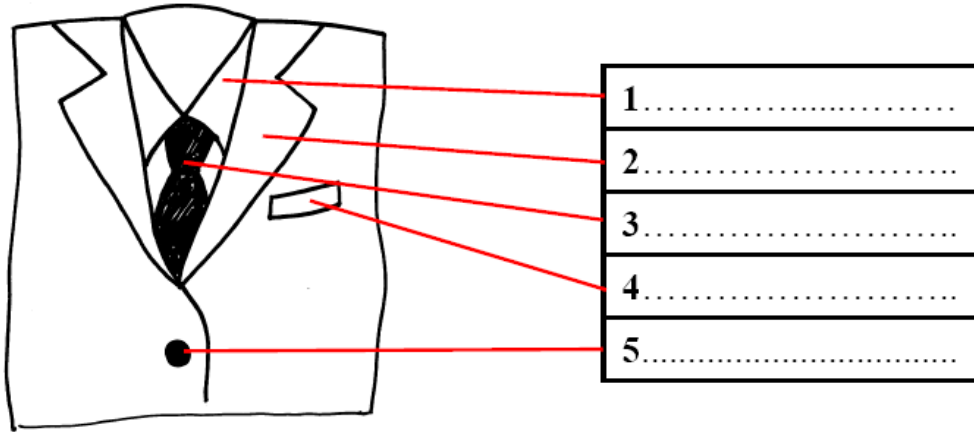
¿En qué se parecen, o tienen en común, un león y un lobo? \_\_\_\_\_

**RECUERDE: LOS BUENOS CIUDADANOS SIEMPRE USAN ZAPATOS OSCUROS**

Por favor, voltee la hoja. Usted no podrá volver a revisar esta plana.

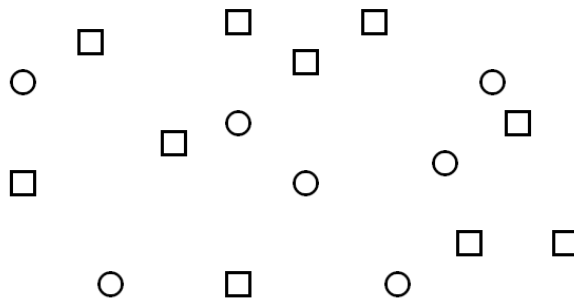
## NOMBRE LOS SIGUIENTES ÍTEMS

/5



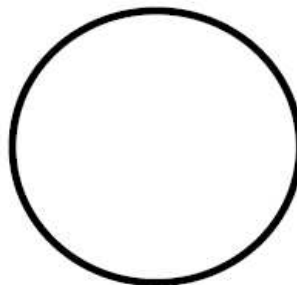
POR FAVOR, UNA LOS CÍRCULOS UNO A UNO PARA FORMAR UNA LETRA (IGNORE LOS CUADRADOS)

/3



DIBUJE EN LA SIGUIENTE CARA DE UN RELOJ TODOS SUS NÚMEROS, DEL 1 AL 12, Y CON LOS PUNTEROS INDIQUE LAS 9:20

/4



**SIN VOLTEAR LA HOJA,** POR FAVOR ESCRIBA A CONTINUACIÓN LA ORACIÓN QUE USTED COPIÓ AL COMIENZO DE ESTA PRUEBA. ESCRIBA TODO LO QUE RECUERDE:

/6

Completado por el evaluador:

AYUDA ENTREGADA: NINGUNA/DISCRETA-TRIVIAL/LEVE/MODERADA/MUCHA  
¿LAS RESPUESTAS FUERON ESCRITAS POR EL PACIENTE? SÍ \_\_\_ NO \_\_\_

/5

TOTAL

/50